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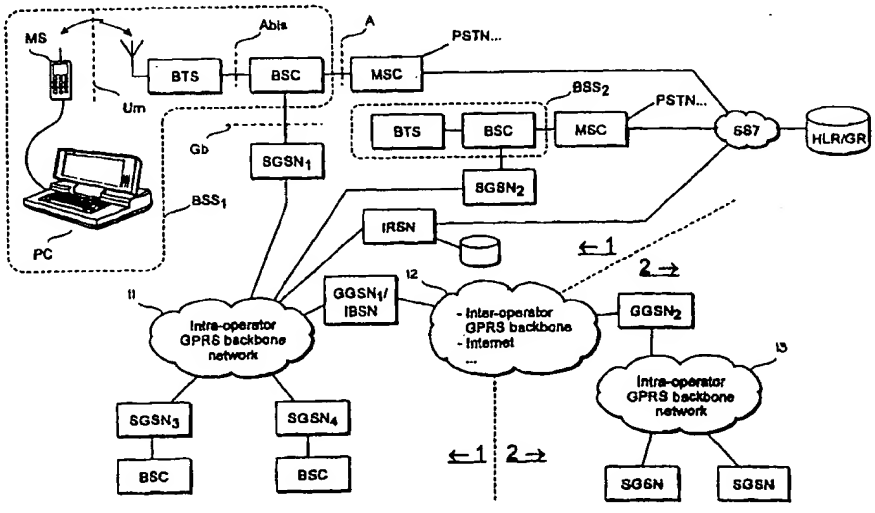

(57) Abstract

Method for maintaining the location of a mobile station (MS) in a packet radio network (1, 2) comprising at least two support nodes (SGSN) and at least one home location register (HLR/GR). As the mobile station (MS) logs on the packet radio network (1, 2) information on the support node (SGSN) serving the mobile station (MS) is transmitted to the home location register (HLR/GR). In the invention, at least one intermediate register (IRSN) is installed in the packet radio network (1, 2), the function of the register being to maintain information on the support node (SGSN) serving the mobile station (MS). As the mobile station (MS) roams from the area of a first support node ($SGSN_1$) to the area of a second support node ($SGSN_2$), the information on the change of support nodes ($SGSN_1$, $SGSN_2$) is stored in said intermediate register (IRSN), whereby the information need not be transmitted to the home location register (HLR/GR). In a preferred embodiment of the invention, a second intermediate register (IBSN) is also installed so as to store information on the support nodes (SGSN) serving mobile stations (MS) that are not in the area of their home networks.

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REDUCTION OF SIGNALLING LOAD IN PACKET RADIO NETWORK

BACKGROUND OF INVENTION

The invention relates to packet radio networks and particularly to reduction of signalling load as a mobile station changes routing areas.

Mobile systems have been developed because it has been necessary to be able to reach people even when they are not close to a fixed telephone terminal. The use of different data transmission services in offices has increased, and different data services have been simultaneously introduced into mobile systems. Portable computers allow efficient data processing wherever the user is. Mobile networks, in turn, offer the user an efficient access network for mobile data transmission, the access network providing access to actual data networks. Because of this, different new data services are being designed for present and future mobile networks. Mobile data transmission is particularly well supported by digital mobile systems, such as the Pan-European mobile system GSM (Global System for Mobile Communication).

A General Packet Radio Service (GPRS) is a new service in the GSM. It is one of the items that is being standardized in GSM phase 2+ in the ETSI (European Telecommunication Standard Institute). The GPRS operational network consists of one or more sub-network service areas that are interconnected using a GPRS backbone network. A sub-network comprises a number of packet data service nodes, which are here called GPRS support nodes (or agents) and each one of which is connected to the GSM mobile network so that it can provide packet data service for mobile data terminals via several base stations, i.e. cells. An intermediate mobile network provides circuit-switched or packet-switched data transmission between a support node and the mobile data terminals. Different sub-networks, in turn, are connected to an external data network, for example to a Public Switched Packet Data Network PSPDN. The GPRS service can thus be used for effecting packet data transmission between mobile data terminals and external data networks, when the GSM network functions as an access network. One feature of the GPRS service network is that it operates almost independently of the GSM network. One of the requirements set for the GPRS service is that it must operate together with different types of external PSPDN networks, such as the Internet and X.25 networks. In other words, the GPRS service and the GSM network should be able to serve all users, irrespective of the type of data

networks that they wish to be connected to via the GSM network. This means that the GSM network and GPRS service must support and process different network addressing methods and data packet formats. The data packet processing also comprises routing of the packets in a packet radio network. In addition, the users should be able to roam from their home GPRS network to a visited GPRS network, whose operator has a backbone network that may support a protocol (for example CLNP) that is different from the one supported by the home network (for example X.25).

With reference to fig. 1, we shall now describe a typical arrangement in a GPRS network. It should be understood that the architecture of the GPRS systems is not as advanced as that of the GSM systems. All GPRS terms should therefore be understood as being descriptive rather than limiting terms. A typical mobile station forming a mobile data terminal consists of a mobile station MS of a mobile network and of a portable computer PC connected to the data interface of the MS. The mobile station can be, for example, a Nokia 2110, manufactured by Nokia Mobile Phones Ltd., Finland. By means of a PCMCIA type Nokia Cellular Datacard, manufactured by Nokia Mobile Phones Ltd., the mobile station can be connected to any portable personal computer PC whatsoever that has a PCMCIA card slot. The PCMCIA card thus provides the PC with an access point that supports the protocol of the telecommunications application used in the PC, such as the CCITT X.25 or Internet Protocol IP. Alternatively, the mobile station can directly provide an access point that supports the protocol used by the PC application. Further, a mobile station 3 and a PC 4 can also be integrated to form a single unit, within which the application is provided with an access point that supports the protocol used by it. An example for such a mobile station with an integrated computer is a Nokia Communicator 9000, manufactured by Nokia Mobile Phones Ltd., Finland.

Network elements BSC and MSC are previously known from a typical GSM network. The arrangement of fig. 1 comprises a separate Serving GPRS Support Node SGSN. The support node controls certain operations of the packet radio service on the network side. The operations include the logging on and off the system by the mobile stations MS, updating of the routing areas of the mobile stations MS, and routing of the data packets to correct destinations. In the present application, the term 'data' should be understood in the wide sense to mean any information whatsoever transmitted

in a digital telecommunications system. The information can comprise speech encoded into digital form, data communication between computers, telefax data, short segments of program code, etc. The SGSN node can be located at a base station BTS, at a base station controller BSC or at a mobile switching centre MSC, or it can be separate from all these elements. The interface between the SGSN node and the base station controller BSC is called a GB interface. An area managed by one base station controller BSC is called a Base Station Subsystem BSS.

The intermediate mobile network provides packet-switched data transmission between a support node and mobile data terminal equipment. Different sub-networks, in turn, are connected to an external data network, for example to a PSPDN, via specific Gateway GPRS Support Nodes GGSN. Packet data transmission between mobile data terminals and external data networks is thus effected by means of the GPRS service, while the GSM network functions as an access network. Alternatively, the gateway node GGSN can be replaced with a router. In the following, the term 'gateway node GGSN' is also to be understood as referring to a structure in which the gateway has been replaced with a router.

In fig. 1 the GPRS network connected to the GSM network comprises a number of serving GPRS support nodes $SGSN_1$ - $SGSN_4$ and one gateway GPRS support node GGSN. The different support nodes SGSN and GGSN are interconnected via an intra-operator backbone network. It is to be understood that a GPRS network can comprise any number of support nodes and gateways. In addition, it may also comprise home GPRS support nodes HGSN, although usually the HGSN functions are in the GGSN node.

Each support node SGSN manages a packet data service in the area of one or more nodes in a cellular packet radio network. To achieve this, each support node SGSN is connected to a certain part of the GSM system, typically to a mobile switching centre, but in some situations it may be preferable to connect it directly to a base station subsystem BSS, i.e. to a base station controller BSC or a base station BTS. A mobile station MS in a cell communicates with a base station BTS over a radio interface Um and further through a mobile network with the support node SGSN to the service area of which the cell belongs. In principle, the mobile network between the support node SGSN and the mobile station MS only transmits packets between these two. For this purpose, the mobile network can offer either a

circuit-switched connection or packet-switched data packet transmission between a mobile station MS and a serving support node SGSN. An example for a circuit-switched connection between a mobile station MS and an agent is presented in Finnish Patent Application 934,115. An example for packet-switched data transmission between a mobile station MS and an agent is presented in Finnish Patent Application 940,314. It should be noted, however, that a mobile network provides only a physical connection between a mobile station MS and a support node SGSN, and that its exact operation and structure are not relevant to the present invention.

An intra-operator backbone network 11 interconnecting the operator's SGSN and GGSN can be implemented, for example, using a local area network. It should be noted that it is also possible to implement the operator's GPRS network without an intra-operator backbone network, for example, by implementing all the features in a single computer, but this does not cause any changes in the call establishment principles according to the present invention.

A gateway GPRS node GGSN connects the operator's GPRS network to the other operators' GPRS systems and to data networks, such as an inter-operator backbone network 12, IP network or X.25 network. An Interworking Function IWF can be arranged between the gateway node GGSN and the other networks. The inter-operator backbone network 12 is one through which the gateway nodes GGSN of different operators can communicate with one another. The communication is needed to support the GPRS roaming between the different GPRS networks.

The gateway node GGSN is also used to store the location information of the GPRS mobile stations. The GGSN also routes mobile-terminated (MT) data packets. The GGSN also contains a database that associates the mobile station's network address, for example in an IP network, X.25 network, CLNP network or simultaneously in more than one of these networks, and the mobile station identifier in a GPRS network. When the mobile station roams from one cell to another within the area of one support node SGSN, location updating is needed only in the support node SGSN, and the gateway node GGSN need not be informed of the change of location. When the mobile station roams from a cell of one support node SGSN to a cell of another SGSN within the area of the same or a different operator, location updating is also performed in the (home) gateway node GGSN so as to store

the identifier of the new, visited support node and the identifier of the mobile station.

A GPRS register GR is used to authenticate subscribers at the beginning of a GPRS session. It contains a definition between a subscriber's PDP (Packet Data Protocol) address/addresses and the subscriber's IMSI (International Mobile Subscriber Identity). In a GSM network a subscriber is identified on the basis of the IMSI. The GR can be a separate register, or preferably it can be integrated with the home location register HLR of the mobile system. In the figure the HLR/GR is connected through an SS7 (Signalling System 7), for example to a mobile switching centre MSC and an intra-operator backbone network. Between the SS7 signalling system and the intra-operator backbone network there can be a direct connection or an SS7 gateway. In principle, the HLR/GR can exchange packet-switched messages with any GPRS node whatsoever. The HLR/GR's method of communication and its connection to the GPRS network are not, however, essential to the invention. For example, a direct connection to a node is possible, or the GR can be a node of the GPRS network.

Fig. 2 illustrates signalling associated with the maintenance of a routing area. For the sake of clarity, fig. 2 is a greatly simplified view showing only the most essential messages. For example, reservation and release of resources, familiar to those skilled in the art, are not shown in fig. 2.

In step 2-1 a mobile station MS logs on a network and sends the network a routing area update, which is forwarded to node $SGSN_1$. In step 2-2 node $SGSN_1$ forwards the message to the home location register HPR/GR. In steps 2-3 and 2-4 corresponding acknowledgements are transmitted to node $SGSN_1$ and to the mobile station MS. The horizontal broken line in fig. 2 indicates where the mobile station MS roams from the area of cell $SGSN_1$ to that of cell $SGSN_2$. Steps 2-5 to 2-8 correspond to steps 2-1 to 2-4, except that the routing area update here passes through node $SGSN_2$. In addition, in step 2-9 the home location register HLR/GR sends a routing area cancel to node $SGSN_1$, which deletes the information on the mobile station MS from its register. In fig. 2, it is assumed that the mobile station MS roams in the home network. If the mobile station MS roamed in a visited network, the routing area update should be routed further via the gateway nodes GGSN to the home network.

A problem in the above-described prior art arrangement is the heavy signalling load between the support node SGSN and the gateway node GGSN on the one hand, and between the support node SGSN and the home location register HLR/GR on the other hand. The signalling load is particularly heavy when the service area of the support node SGSN is small. The roaming of a mobile station in the network brings about much signalling (routing area updating). Always when the mobile station MS roams from the area of a support node (for example $SGSN_1$) to the area of a new support node (for example $SGSN_2$), it sends a routing area update to the network. This causes signalling between the gateway node GGSN and both support nodes SGSN. The problem is at its worst when the mobile station roams in the area of some other network than its home network, since information on the change of routing areas must be transmitted as far as the home network of the mobile station.

Further, the GPRS recommendations according to the prior art suggest that information on the routing area of the mobile station MS (with the accuracy of an SGSN node) should be maintained in the home location register HLR/GR of the network. It can be assumed that as a result of continuous updating of the location of the mobile stations in one network element (home location register HLR/GR), the network element will be subjected to unduly heavy loading.

BRIEF DESCRIPTION OF INVENTION

The object of the invention is to provide a method and equipment implementing the method, simultaneously solving the above problems associated with a heavy signalling load and heavy loading of the home location register HLR/GR. The object of the invention are achieved with a method and arrangement which are characterized by what is stated in the independent claims. The preferred embodiments of the invention are claimed in the dependent claims.

The invention is based on the idea that the architecture of a packet radio network is supplemented with new functionality and/or network elements. A network element as described in the present invention adds a new hierarchic level to a packet radio network according to the GPRS recommendations between the support nodes SGSN and the home location register HLR/GR. In a preferred embodiment of the invention, the network element at the new hierarchic level functions toward the support node SGSN

in the same way as the gateway node GGSN, and toward the gateway node GGSN in the same way as the support node SGSN, whereby the changes needed in the known network elements are minimal, or changes are not needed at all.

An advantage of the method and arrangement according to the invention is that the signalling need and the loading of the home location register HLR/GR are reduced greatly. When the mobile station logs on the network, information on the routing area (with the accuracy of a new network element) is supplied to the home location register HLR/GR, but when the mobile station roams from one SGSN node to another, the information is transmitted only to the new network element at the intermediate level in the hierarchy. There can be many new network elements, for example one per ten SGSN nodes. The address of the actual SGSN node need thus not be forwarded to the home location register HLR/GR, so when the mobile station roams from one SGSN node to another within the area supported by the new network element at the intermediate level of the invention, the home location register HLR/GR need not be informed of anything.

A drop in the signalling need caused by the arrangement of the invention is at its greatest when the mobile station roams in the area of a visited network. The drop in the signalling need is due to the fact that when the mobile station changes routing areas, all the signalling is local signalling between the old and new support nodes SGSN and the new network element of the invention. The signalling need thus not be forwarded as far as the home network of the mobile station. In the home network the situation looks the same as in the prior art packet radio network, i.e. in the home network it seems that the location of the mobile station is known with the accuracy of a support node SGSN. In reality, the location of the mobile station is known in the home network with the accuracy of a new network element of the invention, and the location of the mobile station within the area supported by the network element is known on the basis of the registers of this particular network element. Since the signalling need not be forwarded as far as the home network of the mobile station, a routing area is quicker to update than in a network where the arrangement according to the invention has not been implemented.

The arrangement according to the invention is transparent to the other network elements of the mobile network, to the users and to other

networks. The invention does thus not require any changes in the support nodes SGSN, gateway nodes GGSN (or routers replacing them), nor in the other networks.

BRIEF DESCRIPTION OF FIGURES

In the following the invention will be described in greater detail in connection with preferred embodiments, with reference to the attached drawings, in which

fig. 1 illustrates prior art packet network architecture,

fig. 2 illustrates signalling associated with maintenance of a routing area, in accordance with the prior art,

fig. 3 illustrates packet network architecture supplemented in accordance with the invention, and

fig. 4 illustrates signalling associated with maintenance of a routing area, implemented in accordance with the invention.

DETAILED DESCRIPTION OF INVENTION

With reference to fig. 3, the extra hierarchic level according to the invention between the support nodes SGSN and the home location register HLR/GR can be implemented using a new network element, which in this application is called an Intermediate Register Support Node IRSN. The operation of the IRSN can be described as follows:

Seen from the direction of the support nodes SGSN, the IRSN node functions as a common gateway to several support nodes SGSN to the direction of the signalling system (such as SS7).

Seen from the direction of the signalling system (such as SS7), the IRSN node operates like a large support node SGSN.

When a mobile station is logged on a packet network, information on the support node SGSN in the area of which the mobile station MS is located is maintained in the IRSN node.

When the mobile station logs off the packet network, the IRSN node keeps in memory the information on the support node SGSN in the area of which the mobile station MS has been located last.

The IRSN node stores information on the mobile station as the mobile station changes support node SGSN areas in the network of one and the same operator.

In a preferred embodiment of the invention, traffic toward the other operators is also supplemented with a corresponding functionality, which in this application is called an Intermediate Backbone Support Node IBSN. Fig. 3 shows a situation in which the functionality is implemented in the network 1 of the first operator toward the network 2 of the second operator. In fig. 3 the intermediate backbone support node IBSN is integrated into gateway node $GGSN_1$, but the intermediate backbone support node IBSN can also be implemented as a separate network element. The operation of the intermediate backbone support node IBSN can be described as follows:

Seen from the direction of the gateway node GGSN, the intermediate backbone support node IBSN functions like a large support node SGSN.

Seen from the direction of the support node SGSN, the IBSN functions like a common gateway node GGSN.

When the gateway node GGSN sends a mobile-terminated packet to the intermediate backbone support node IBSN, the IBSN searches its register for the support node SGSN that is serving the mobile station and forwards the packet to the SGSN. From the point of view of the support node SGSN, the situation resembles one in which the packet has been received directly from the gateway node GGSN. From the point of view of the gateway node GGSN, the situation resembles one in which the packet has been sent directly to the support node SGSN.

Correspondingly, when the support node SGSN sends a mobile-originating packet to the intermediate backbone support node IBSN, the IBSN forwards the packet to the correct gateway node GGSN. From the points of view of the support node SGSN and the gateway node GGSN, the situation resembles one in which they communicate directly with each other.

When a mobile station MS in a visited network (for example in the network 1 of the first operator) roams from the area of an old support node (for example $SGSN_1$) to that of a new support node (for example $SGSN_2$), the routing area updates propagate as far as the IBSN node, but they need not be transmitted as far as the gateway node $GGSN_2$ of the home network (here the network 2 of the second operator), since from the point of view of $GGSN_2$ the SGSN node does not change.

Fig. 4 illustrates signalling associated with maintenance of a routing area, implemented in accordance with the invention. Steps 4-1 to 4-4

correspond to steps 2-1 to 2-4, except that in step 4-2 the information on the change of routing areas is also supplied to the intermediate register support node IRSN, which acknowledges the reception of the message in step 4-3. Between these, in step 4-2' the intermediate register support node IRSN sends the same information to the home location register HLR/GR, which acknowledges the reception of the message in step 4-3'. Likewise, steps 4-5 to 4-9 correspond to steps 2-5 to 2-9, except that here (when the support node SGSN changes in the area of one and the same intermediate register support node IRSN) the routing area update is forwarded only to the intermediate register support node IRSN but not to the home location register HLR/GR.

The invention also has other embodiments. For example, an intermediate backbone support node IBSN can always be used, whereby all the support nodes SGSN, including the IBSN, function outward like a large SGSN node. Alternatively, the IBSN node can be used for all traffic that is routed outward of the operator's network. The advantage of this particular embodiment is that the information on the change of support nodes SGSN need not be updated in the GGSN when the mobile station roams only within the PLMN network. According to yet another alternative embodiment, the IRSN node can communicate with a signalling system SS7 or a mobile switching centre MSC, whereby no changes are needed in the support node SGSN.

It will be obvious to those skilled in the art that as the technology advances, the basic idea of the invention can be implemented in many different ways. The invention and its embodiments are thus not limited to the above examples but can be varied within the scope of the claims.

CLAIMS

1. A method for hierarchically maintaining the location of a mobile station (MS) in a packet radio network (1, 2) comprising at least one home location register (HLR/GR) and at least two support nodes ($SGSN_1$, $SGSN_2$) in such a way that the home location register is at the top level of the hierarchy and the support nodes are at a lower level;

in the method, as the mobile station (MS) logs on the packet radio network (1, 2), information on the support node ($SGSN_1$) serving the mobile station (MS) is transmitted to the home location register (HLR/GR);

characterized by

installing at least one intermediate register (IRSN) in the packet radio network (1, 2), the function of the register being to maintain the information on the support node ($SGSN_1$, $SGSN_2$) serving the mobile station (MS);

placing the intermediate register in the location updating hierarchy at a level where it is lower than the home location register but higher than the support nodes;

as the mobile station (MS) roams from the area of a first support node ($SGSN_1$) to that of a second support node ($SGSN_2$), information on the change of support nodes ($SGSN_1$, $SGSN_2$) is stored in said intermediate register (IRSN); and

if the first and the second support nodes ($SGSN_1$, $SGSN_2$) are subject to the same intermediate register (IRSN), information on the change of support nodes is not transmitted to the home location register (HLR/GR).

2. A method according to claim 1 for maintaining the location of the mobile station (MS) in a packet radio network (1) that is not the home network (2) of the mobile station (MS) and that is connected via a gateway/router ($GGSN_1$) to the home network (2) of the mobile station, **characterized** by

including in or connecting to the gateway/router ($GGSN_1$) a second intermediate register (IBSN) for storing information on the support nodes (SGSN) that serve mobile stations (MS) that are not in the area of their home network;

as the mobile station (MS) in a visited network (1) roams from the area of the first support node ($SGSN_1$) to that of the second support node ($SGSN_2$), information on the change of support nodes ($SGSN_1$, $SGSN_2$) is

stored in said second intermediate register (IBSN), whereby the information need not be transmitted to the home network (2).

3. A method according to claim 1, **characterized** in that the first intermediate register (IRSN) uses the protocol of the support node (SGSN) toward the home location register (HLR/GR) and the protocol of the home location register toward the support node (SGSN).

4. A method according to claim 2 or 3, **characterized** in that the second intermediate register (IBSN) uses the protocol of the support node (SGSN) toward the gateway/router (GGSN) and the protocol of the gateway/router (GGSN) toward the support node (SGSN).

5. A method according to claim 2 or 4, **characterized** in that a packet terminating at a mobile station (MS) roaming in a visited network (1) is routed from the external network (2) by using the second intermediate register (IBSN), which retrieves the information on the support node (SGSN) serving the mobile station (MS) from its memory.

6. An arrangement for updating the location of a mobile station (MS) in a packet radio network (1, 2) comprising at least two support nodes ($SGSN_1$, $SGSN_2$, ...) and at least one home location register (HLR/GR), in which arrangement:

the home location register (HLR/GR) is on the top level of the hierarchy and the support nodes ($SGSN_1$,$SGSN_2$, ...) are at a lower level; and

the home location register (HLR/GR) contains information on the support node ($SGSN_1$, $SGSN_2$, ...) in the area of which the mobile station (MS) has logged on the network (1, 2);

characterized in that

the packet radio network (1, 2) also comprises at least one intermediate register (IRSN) for storing information on the support node ($SGSN_1$, $SGSN_2$, ...) that is serving the mobile station (MS);

in the location updating hierarchy, the intermediate register (IRSN) is at a level where it is lower than the home location register (HRL/GR) but higher than the support nodes ($SGSN_1$, $SGSN_2$, ...);

the packet radio network (1, 2) is arranged to store information on the roaming of the mobile station (MS) from the area of the first support node ($SGSN_1$) to the area of the second support node ($SGSN_2$) in said intermediate register (IRSN) but not in the home location register (HLR/GR) if the first and

second support nodes ($SGSN_1$, $SGSN_2$) are subject to the same intermediate register (IRSN).

7. An arrangement according to claim 6 for maintaining the location of the mobile station (MS) in a packet radio network (1) that is not the home network of the mobile station (MS) and that is connected via a gateway/router ($GGSN_1$) to the home network (2) of the mobile station, **characterized** in that

a second intermediate register (IBSN) is contained in or connected to the gateway/router ($GGSN_1$) so as to store information on the support nodes ($SGSN_1$, $SGSN_2$, ...) serving mobile stations (MS) that are not in the area of their home network (2);

the packet radio network (1) is arranged to store in said second intermediate register (IBNS) information on the roaming of the mobile station (MS) from the area of the first support node ($SGSN_1$) to the area of the second support node ($SGSN_2$) in a visited network (1), whereby the information need not be transmitted to the home network (2).

Fig. 1

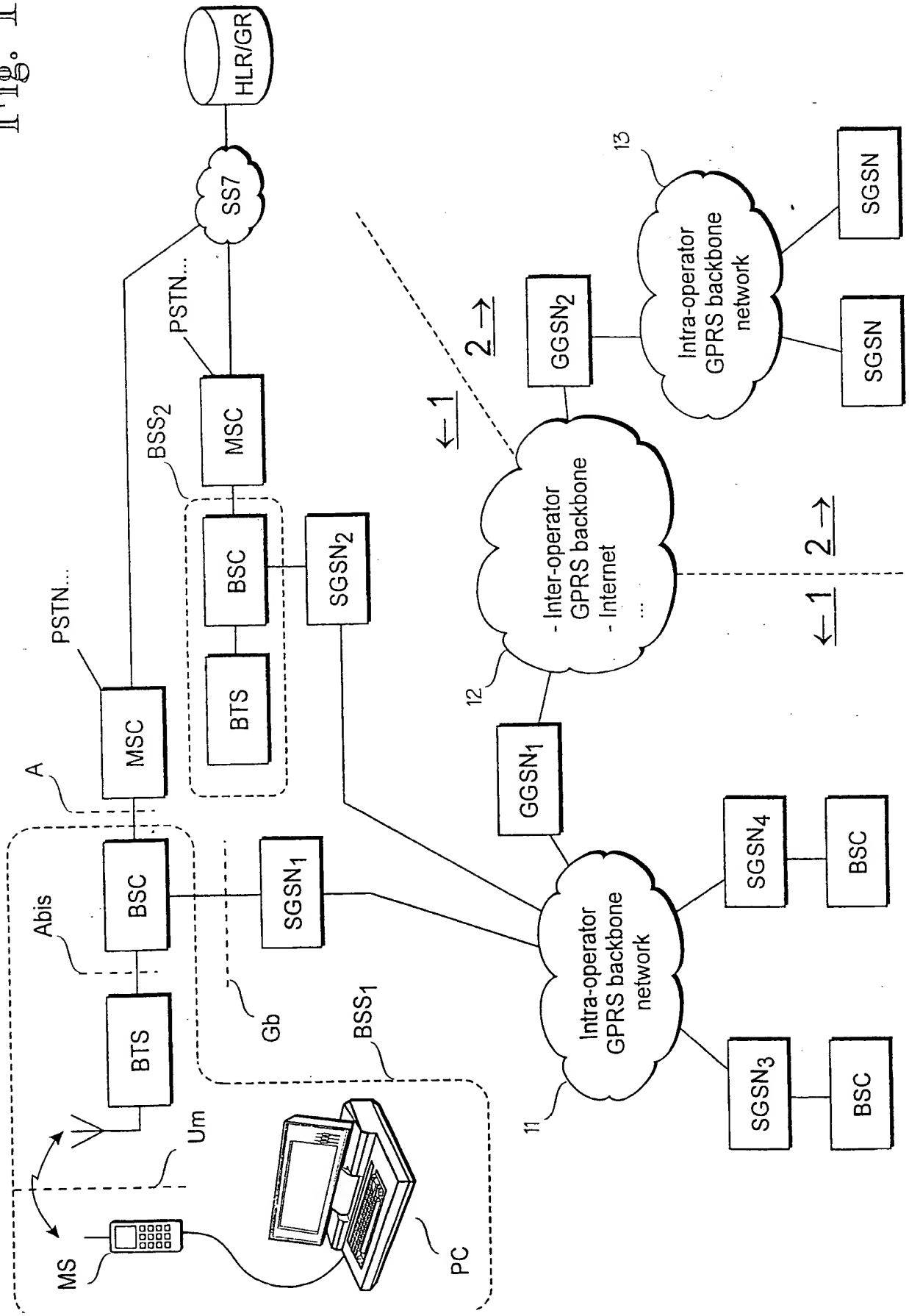

HLR/GR
SS7
PSTN...
MSC
BSS2
BSC
BTS
SGSN2
PSTN...
MSC
A
BSC
Abis
BTS
Um
MS
PC
SGSN1
Gb
BSS1
GGSN2
Intra-operator GPRS backbone network
SGSN
SGSN
13
2 →
← 1
- Inter-operator GPRS backbone
- Internet
...
12
2 →
← 1
GGSN1
11
Intra-operator GPRS backbone network
SGSN4
BSC
SGSN3
BSC

Fig. 2

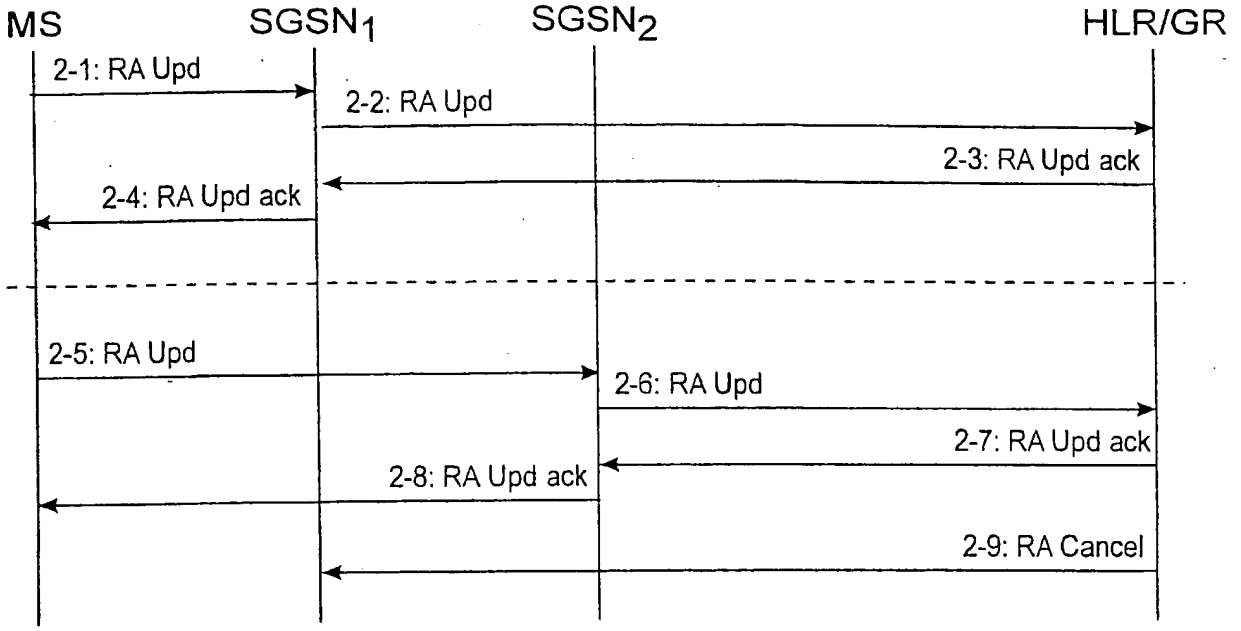

MS
SGSN1
SGSN2
HLR/GR
2-1: RA Upd
2-2: RA Upd
2-3: RA Upd ack
2-4: RA Upd ack
2-5: RA Upd
2-6: RA Upd
2-7: RA Upd ack
2-8: RA Upd ack
2-9: RA Cancel

Fig. 4

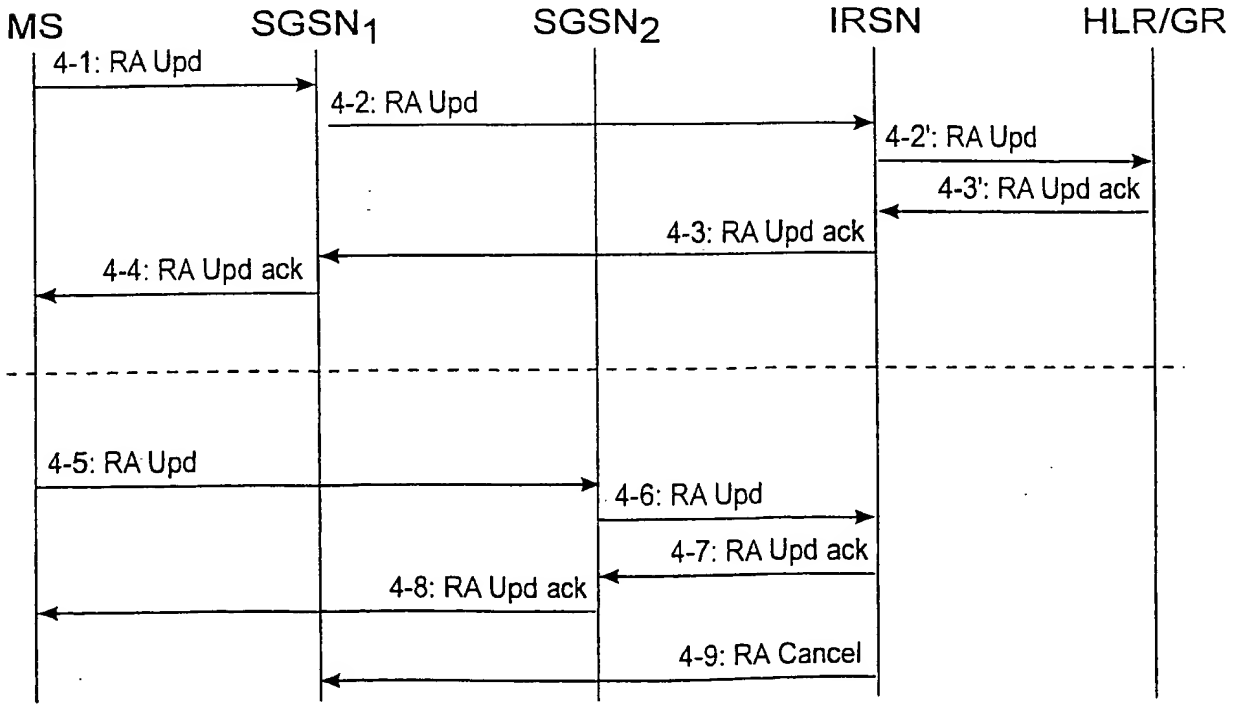
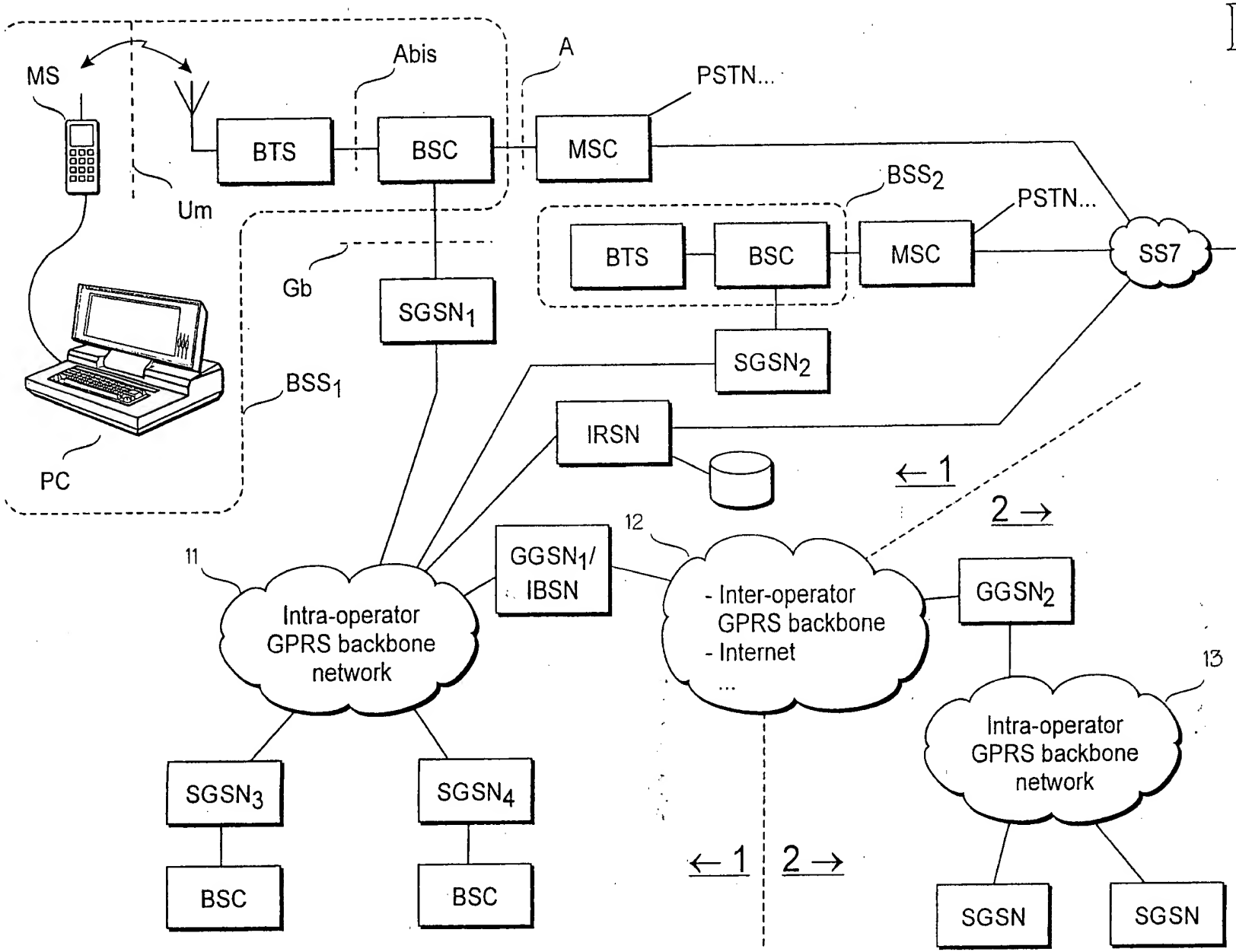

MS
SGSN1
SGSN2
IRSN
HLR/GR
4-1: RA Upd
4-2: RA Upd
4-2': RA Upd
4-3': RA Upd ack
4-3: RA Upd ack
4-4: RA Upd ack
4-5: RA Upd
4-6: RA Upd
4-7: RA Upd ack
4-8: RA Upd ack
4-9: RA Cancel

Fig. 3


MS
Abis
A
PSTN...
BTS
BSC
MSC
Um
BSS2
PSTN...
BTS
BSC
MSC
SS7
HLR/GR
Gb
SGSN1
SGSN2
BSS1
IRSN
PC
← 1
2 →
12
11
GGSN1/
IBSN
- Inter-operator
GPRS backbone
- Internet
...
GGSN2
Intra-operator
GPRS backbone
network
13
Intra-operator
GPRS backbone
network
SGSN3
SGSN4
← 1
2 →
BSC
BSC
SGSN
SGSN